Treatment strategy for chylothorax after pulmonary resection and lymph node dissection for lung cancer

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Objective: We reviewed our experience with iatrogenic chylothorax after pulmonary resections for lung cancer to evaluate our treatment strategy and to identify factors that predict the need for reoperation.

Methods: From July 1992 through February 2000, a total of 1110 patients underwent pulmonary resection (at least lobectomy) and systematic mediastinal lymph node dissection for lung cancer at our division. Twenty-seven patients (2.4%) had postoperative chylothorax develop. We initially treated 26 of these patients conservatively with complete oral intake cessation and total parenteral nutrition, and these patients constituted the subjects in this study.

Results: There were 21 men and 5 women with a median age of 62 years (range 44 to 80 years). The initial procedures were pneumonectomy in 2 cases, bilobectomy in 1 case, and lobectomy in 23 cases. Twenty-one patients (81%) had the condition cured with conservative treatment. These patients resumed a normal diet at a median of 8 days after chylothorax diagnosis (range 4-35 days). The remaining 5 patients (19%) underwent reoperation at a median of 14 days after diagnosis (range 5-35 days). Chest tube drainage of less than 500 mL during the first 24 hours after complete oral intake cessation and total parenteral nutrition predicted a cure with conservative treatment.

Conclusion: Although most cases of chylothorax after pulmonary resection with systematic mediastinal lymph node dissection can be cured with a conservative strategy, early surgical intervention may be indicated if chest tube drainage is more than 500 mL during the first 24 hours after complete oral intake cessation and total parenteral nutrition.

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Postoperative chylothorax is a rare but well-known complication in thoracic surgery.¹ The thoracic duct lies posterior to the aorta and courses to the right of the spine. It usually crosses to the left ventral to the fifth thoracic vertebra, ascends into the neck posterior to the aortic arch, and empties into the left jugulosubclavian junction. Its proximity to the trachea, the presence of collateral channels, and its highly variable anatomic course can lead to an injury to this lymphatic flow during pulmonary resection, especially during mediastinal lymph node dissection. We reviewed our experience with iatrogenic chylothorax after pulmonary resection with systematic mediastinal lymph node dissection for lung cancer, as previously described by Naruke,² to evaluate our treatment strategy and to identify factors that predict the need for reoperation.

TABLE 1. Patient characteristics

	No. of patients
Gender	
Male	21
Female	5
Postoperative N status	
N0	17
N1	4
N2	5
Pathologic stage	
IA	6
IB	10
IIA	0
IIB	4
IIIA	3
IIIB	3
Tumor location	
Right upper lobe	11
Right middle lobe	2
Right lower lobe	5
Left upper lobe	8
Operation	
Pneumonectomy	2
Bilobectomy	1
Lobectomy	23

Patients and Methods

From July 1992 through February 2000, a total of 1110 patients underwent pulmonary resection (at least lobectomy) and systematic mediastinal lymph node dissection for lung cancer at our division, as described previously elsewhere.² Postoperative chylothorax developed in 27 patients (2.4%), and these patients constituted the subjects in this study. Chylothorax was diagnosed on the basis of chylous leakage from the chest tube. The diagnosis was confirmed by presence of triglycerides (>110 mg/dL) and chylomicrons in the drainage fluid.³ The medical records of these patients were reviewed for age, sex, surgical procedures, pathologic findings, amount of chest tube drainage, and chylothorax treatment methods. Lung cancer was pathologically staged according to the TMN classification system of the American Joint Committee on Cancer Staging.⁴

We initially treated all but one of these patients conservatively with complete oral intake cessation and total parenteral nutrition (TPN); the exception was treated with a medium-chain triglyceride diet and was therefore excluded from the study. If chest tube drainage did not decrease significantly in about 3 days, we performed pleurodesis by injecting a preparation of 10 kE OK-432 plus 20 mL 1% lidocaine plus 20 mL isotonic sodium chloride solution (Picibanil; Chugai Pharmaceutical Co Ltd, Tokyo, Japan) into the thoracic cavity through a chest tube.⁵ If chylothorax was not cured in about 2 weeks, the conservative strategy was considered unsuccessful and surgical intervention was indicated.

Results

There were 21 male and 5 female patients. Their ages ranged from 44 to 80 years, with a median age of 62 years. Patient characteristics are shown in Table 1. Pneumonectomy

was performed in 2 cases, with the chest tube kept in place until the third postoperative day for unrecorded reasons in 1 case. Bilobectomy was performed in 1 case, and lobectomy was performed in 23 cases. All patients had a single chest tube placed after the initial operation. All chylothoraces developed on the ipsilateral side. Chylothorax was diagnosed at a median of 2 days after operation (range 1-3 days; Table 2). All patients were treated with complete oral intake cessation and TPN. Fifteen patients (58%) received pleurodesis with OK-432 (Table 2), and 13 (87%) of them had the condition cured with the conservative treatment. There were no procedure-related complications, drug-related complications, or deaths related to the thoracic cavity injection of OK-432. The only adverse effects, fever and chest pain, were mild and controllable by medication. In total, 21 patients (81%) had the chylothorax cured with this conservative strategy. These patients resumed a normal diet at a median of 8 days after chylothorax diagnosis (range 4-35 days). One patient resumed a normal diet at 35 days after chylothorax diagnosis, whereas all the others did so between 4 and 15 days after chylothorax diagnosis.

The remaining 5 patients (19%) underwent reoperation. The median chest drainage volume during the first 24 hours after complete oral intake cessation and TPN in this group was 706 mL, as opposed to 215 mL for the patients who had the condition cured by the conservative strategy. The chest drainage volume during the first 24 hours after complete oral intake cessation and TPN for the conservative cure group did not exceed 500 mL (Figure 1). Reoperation was performed at a median of 14 days after pulmonary resection (range 5-35 days). Reoperation was successful in all cases.

There were no deaths among the 26 patients. Complications occurred in 4 cases (15%): atrial fibrillation in 1 patient, pneumonia in 2 patients, and a mediastinal chyloma after seemingly successful conservative treatment in 1 patient.⁶

Discussion

Postoperative chylothorax is an uncommon but well-known complication in thoracic surgery. In our review, we encountered 27 patients (2.4%) with chylothorax among 1110 who underwent pulmonary resection and systematic mediastinal lymph node dissection for lung cancer in our division. Our incidence was much higher than the 0.5% reported by Vallieres and associates⁷ or the 0.26% reported by Cerfolio and coworkers.¹ Those reports, however, described few technical details on lymph node dissection or sampling. In our study all patients underwent uniform, systematic mediastinal lymph node dissection, as described previously elsewhere.² Bollen and associates⁸ reported that 2 patients (3%) who underwent systematic mediastinal lymph node dissection had chylothorax develop. Izbicki and colleagues⁹ reported that 1 chylothorax (1.2%) occurred in their system-

TABLE 2. Patient data

Patient	Age (y)	Operation	Diagnosis (POD)	Chest tube drainage (mL)*	OK432†	Outcome	Reoperation (POD)	Discharge (POD)
1	61	Left upper lobectomy	1	150		Success		21
2	44	Right upper lobectomy	1	200		Success		24
3	47	Left pneumonectomy	3	170	Yes	Success		30
4	80	Right lower lobectomy	2	300		Success		22
5	68	Right lower lobectomy	1	360		Success		21
6	53	Right lower lobectomy	2	310	Yes	Success		28
7	69	Right lower lobectomy	3	180		Success		20
8	72	Right upper lobectomy	2	770		Failure	35	54
9	78	Right upper lobectomy	3	1040		Failure	17	32
10	56	Left upper lobectomy	2	230	Yes	Success		43
11	65	Left pneumonectomy	1	245	Yes	Failure	22	43
12	77	Right upper lobectomy	2	185		Success		14
13	70	Left upper lobectomy	2	230	Yes	Success		25
14	71	Right upper lobectomy	2	90	Yes	Success		23
15	57	Left upper lobectomy	2	960		Failure	5	30
16	56	Left upper lobectomy	2	47	Yes	Success		21
17	69	Right upper lobectomy	2	170	Yes	Success		19
18	60	Right upper lobectomy	2	100	Yes	Success		19
19	61	Right middle and lower bilobectomy	1	516	Yes	Failure	14	26
20	62	Right upper lobectomy	2	120	Yes	Success		21
21	54	Right upper lobectomy	1	365	Yes	Success		27
22	60	Right upper lobectomy	2	420		Success		16
23	79	Right upper lobectomy	2	225	Yes	Success		17
24	59	Right lower lobectomy	1	120		Success		14
25	71	Left upper lobectomy	3	335	Yes	Success		16
26	61	Right middle lobectomy	1	305	Yes	Success		14

POD, Postoperative day.

*Chest tube drainage during first 24 hours after complete oral intake cessation and TPN.

†Pleurodesis by intrathoracic OK432 injection.

atic mediastinal lymph node dissection group. Their results were comparable to ours.

The basic principle of conservative chylothorax treatment is to inflate the lung to decrease the dead space in the thoracic cavity and to promote adhesion of the lung or pleura to the thoracic duct injury. It is important to reduce chylous leakage to decrease the dead space and to prompt adhesion and accelerate fistula closure. Thoracic duct flow increases after meals, especially when a high-fat meal is ingested.¹⁰ Because starvation reduces the thoracic duct flow, our patients had complete oral intake cessation and TPN after chylothorax diagnosis. Promotion of adhesion of the lung or pleura to the thoracic duct injury by pleurodesis may play an important role. OK-432, a heat- and penicillin-treated lyophilized preparation of the Su strain of *Streptococcus pyogenes* A3,¹¹ has been reported to be effective and safe in managing chylothorax.⁵ Thoracic cavity injection of OK-432 promotes fibrin clot development, which has been reported to facilitate pleurodesis.⁵ Among the 15 patients who underwent pleurodesis with OK-432, 13 (87%) were successfully treated without any major complications. Our

study confirmed that OK-432 is effective and safe in managing postoperative chylothorax. However, we previously reported a mediastinal chyloma after seemingly successful conservative treatment with OK-432.⁶ Although that patient might have had a chyloma develop even without OK-432 and the causal relationship between OK-432 and mediastinal chyloma was unclear, it should be noted that a chyloma may develop during the clinical course of chylothorax.

Surgical treatment generally involves ligation of the thoracic duct. The criteria for surgical intervention described by Selle and coworkers¹² are most frequently used in clinical practice. Selle and coworkers¹² recommend reoperation to ligate the thoracic duct when chylous leakage persists for at least 5 days at the rate of 1500 mL/day or more in adults and when the drainage of chyle does not decrease within 2 weeks or the patient's nutrition or metabolic status becomes measurably more impaired during the same period. Cerfolio and coworkers¹ and Patterson and colleagues¹³ have reported similar strategies. They recommend observation for 7 days; if drainage is still greater than 1000 mL/day, reoperation to ligate the thoracic duct is necessary. If drainage is

Figure 1. Chest tube drainage during the first 24 hours after complete oral intake cessation and TPN. Statistically significant difference was observed between groups ($P < .0001$ by t test).

Figure 2. Treatment strategy for postoperative chylothorax. COIC, Complete oral intake cessation.

higher or chylothorax occurs after an esophageal operation, early reoperation should be strongly considered. These strategies were derived from retrospective analyses of heterogeneous patients who underwent general thoracic surgical procedures, including cardiovascular surgery and esophageal resection with mediastinal lymphadenectomy. Our study, in contrast, retrospectively analyzed a homogeneous series of consecutive patients who underwent pulmonary resection and systematic mediastinal lymph node dissection. This study showed that chest tube drainage less than 500

mL during the first 24 hours after complete oral intake cessation and TPN predicted a cure with conservative treatment. On the basis of our experience, we recommend the treatment flow chart shown in Figure 2.

Chylothorax is an infrequent postoperative complication. However, pulmonary resection for lung cancer with systematic mediastinal lymph node dissection may lead to a higher incidence of postoperative chylothorax than is seen with other general thoracic surgical procedures, except for esophageal resection with mediastinal lymphadenectomy.¹ Although most chylothoraces after pulmonary resection with systematic mediastinal lymph node dissection can be cured with a conservative strategy, immediate reoperation may be indicated to expedite recovery and minimize hospital stay if chest tube drainage is more than 500 mL during the first 24 hours after complete oral intake cessation and TPN.

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